UNIVERSITÉ DE SHERBROOKE

Cartel
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USING STATISTICAL METHODS TO DISAGGREGATE THE SPATIAL RESOLUTION OF SMOS DERIVED SOIL MOISTURE

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Introduction

- Usually the available soil moisture data is not in proper spatial resolution for some applications.
- Spatial disaggregation methods are generally based on combination by a higher resolution satellite data.
- Another solution is based on using multiplicative random cascade method:
  - Has been used to spatial downscale of coarse resolution rainfall data.
- This is the first attempt to use the discrete multiplicative random cascade method to disaggregate surface soil moisture.

Study area and dataset

- The used dataset was collected over two agricultural areas:
  - Canadian Experiment for Soil Moisture in 2010 (CanEX-SM10).
    - Volumetric soil moisture range is 0.27-0.36 m^3/m^3.
  - Soil moisture Experiment in 2003 (SMEX03).
    - Volumetric soil moisture range is 0.01-0.26 m^3/m^3.
  - Two SMOS images that measured over CanEX-SM10 study area on 2-June-2010 and 13-June-2010.

Study area and dataset

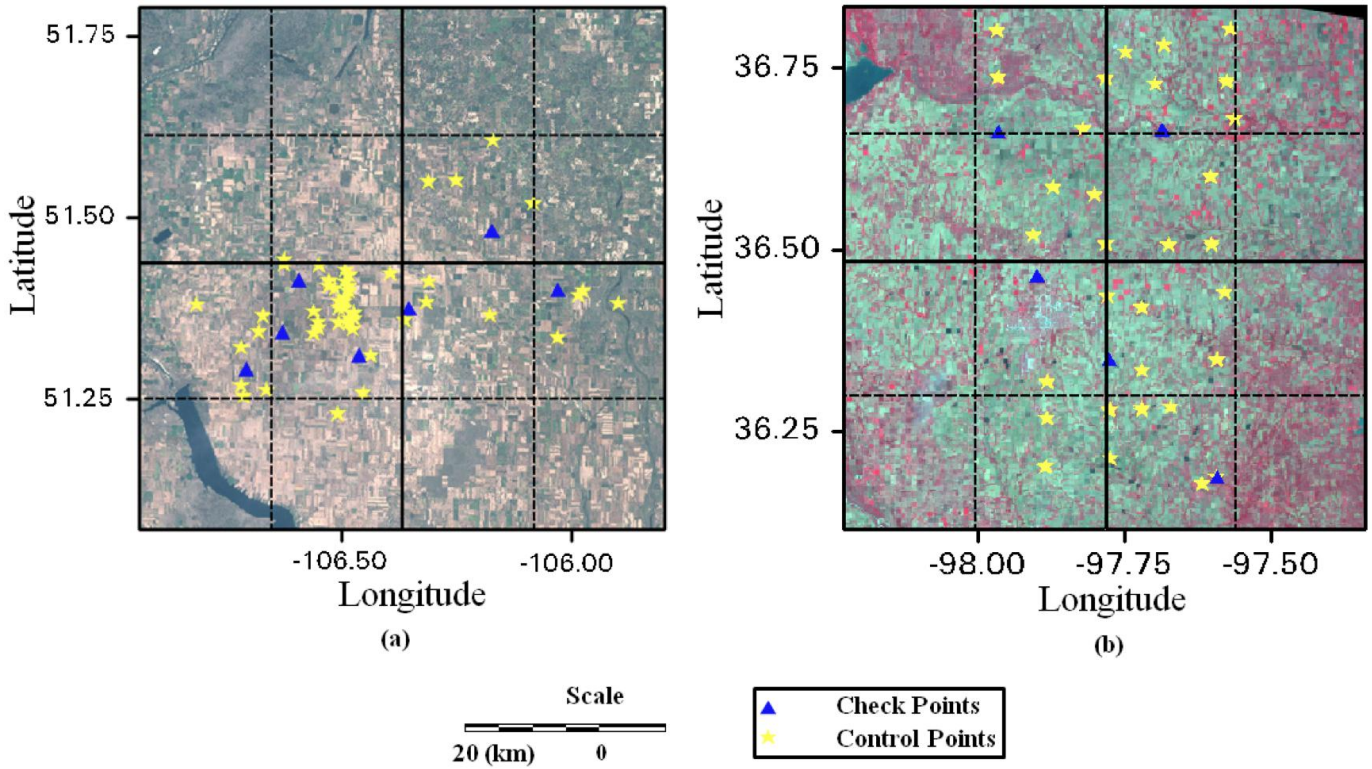


Figure 1. True composite colors of Landsat-5 TM images (a) over CanEX-SM10 study area on 7th April, 2010, (b) over SMEX03 study area on 10th July, 2003.

Methodology

- **Rationale**:

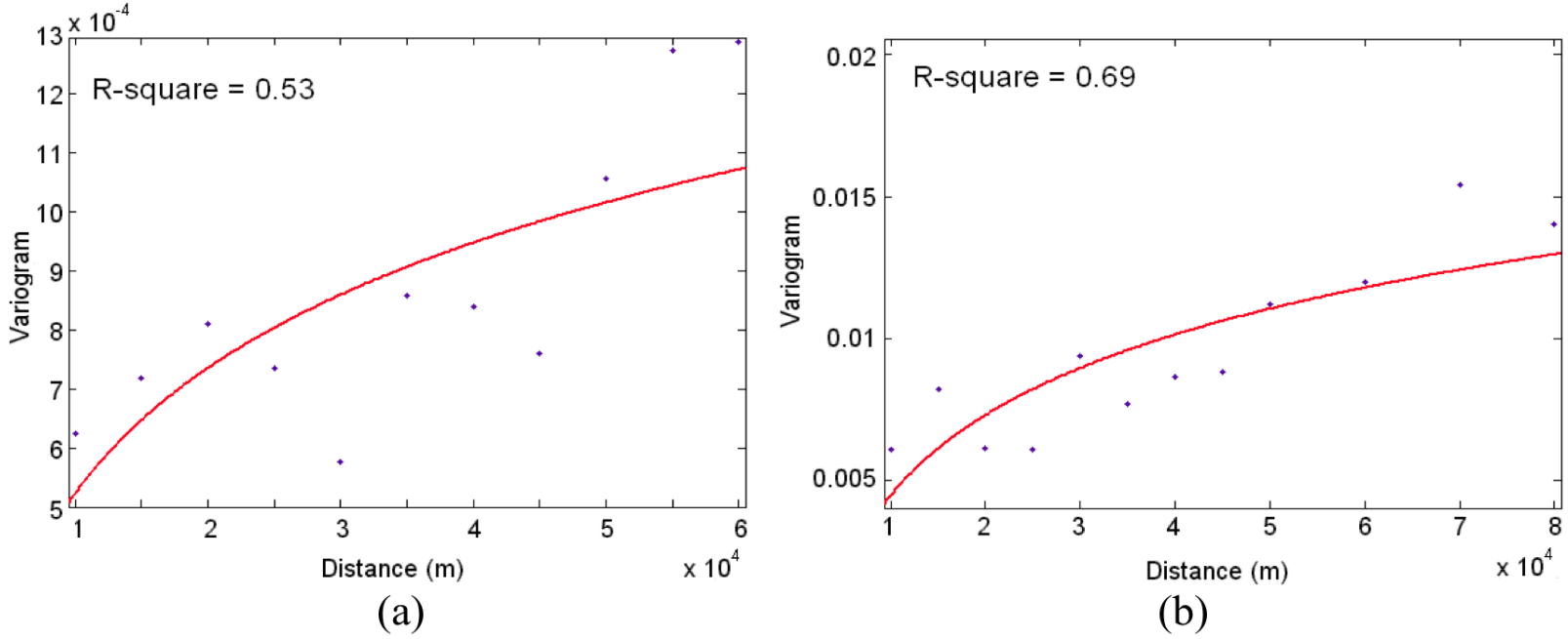


Figure 2. Semivariogram of soil moisture measurements: (a) CanEX-SM10 on June 2, 2010, and (b) SMEX03 on July 10, 2003.

Methodology

- **Multiplicative random cascade model**

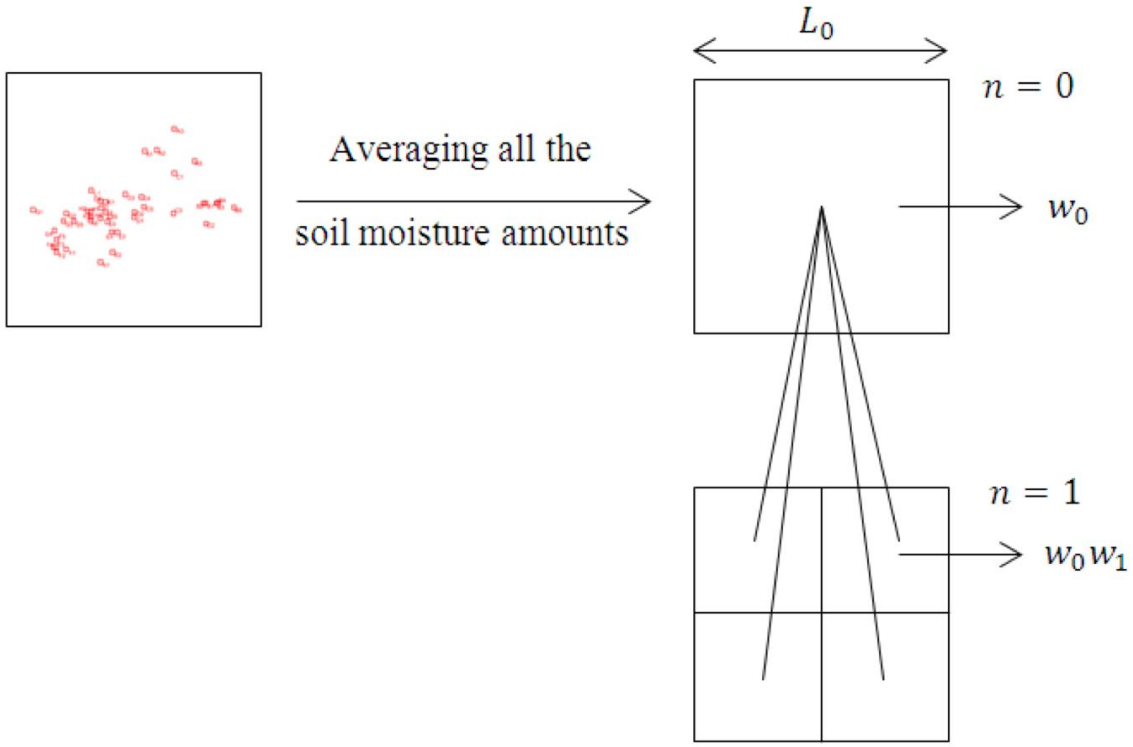


Figure 3. Schematic representation of the discrete multiplicative random cascade process.

Results and discussions

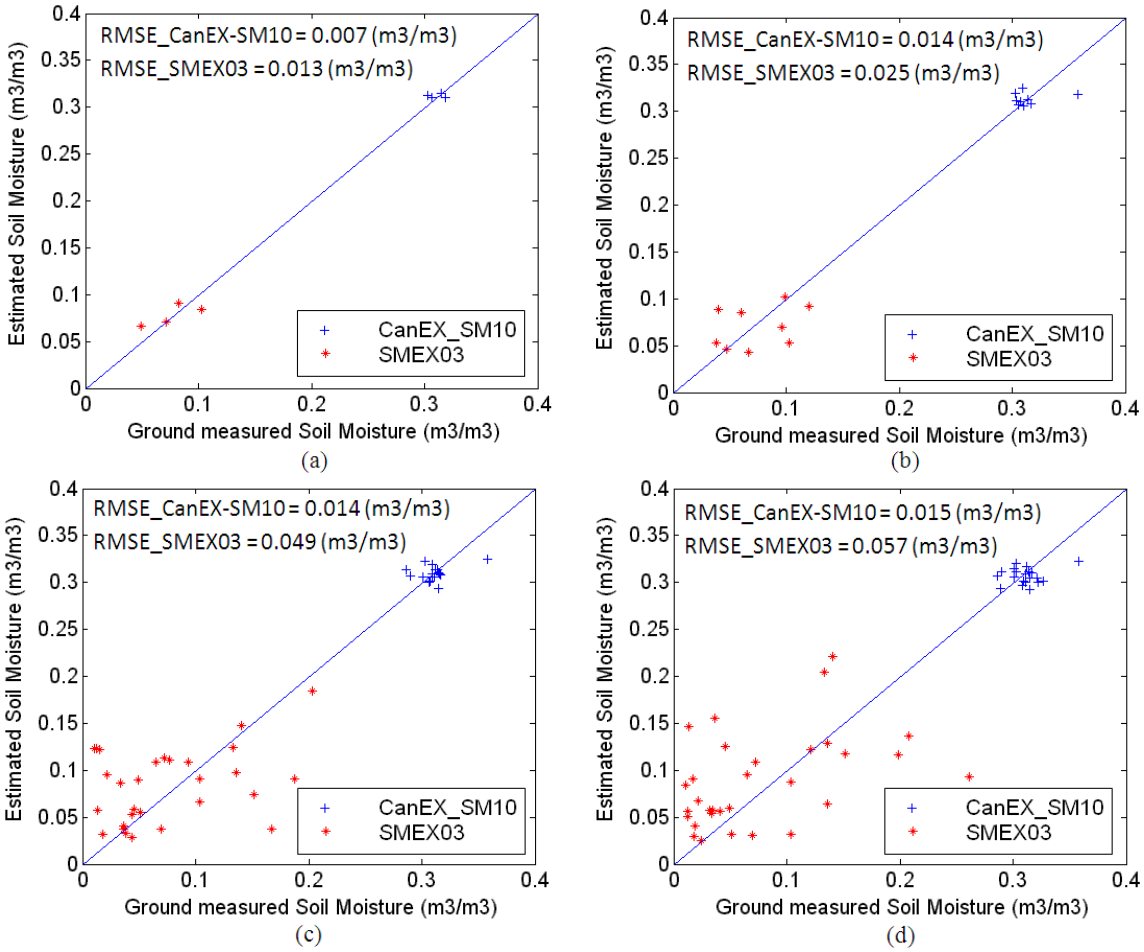


Figure 4. Disaggregated soil moisture versus ground measurements on June 2, 2010 for CanEX-SM10 and July 10, 2003 for SMEX03 at different levels: (a) level 1, (b) level 2, (c) level 3 and (d) level 4 for control points.

Results and discussions

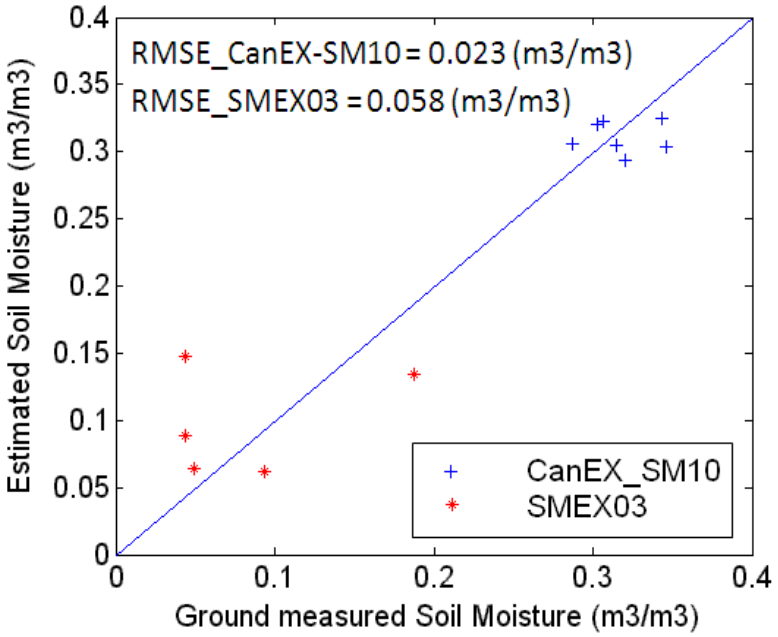
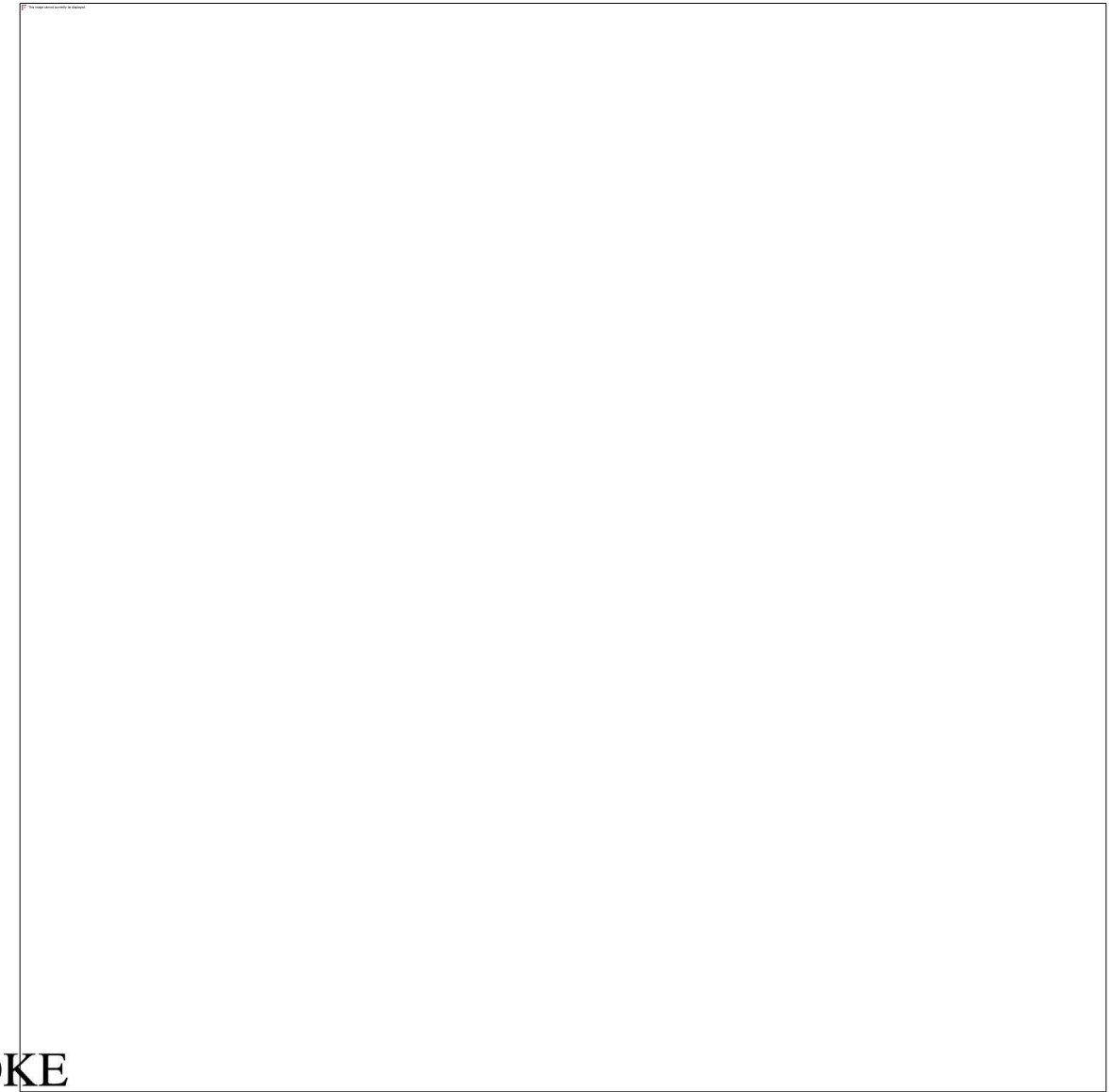


Figure 5. Disaggregated soil moisture versus ground measurements at level 4 for check points.

Results and discussions



Results and discussions

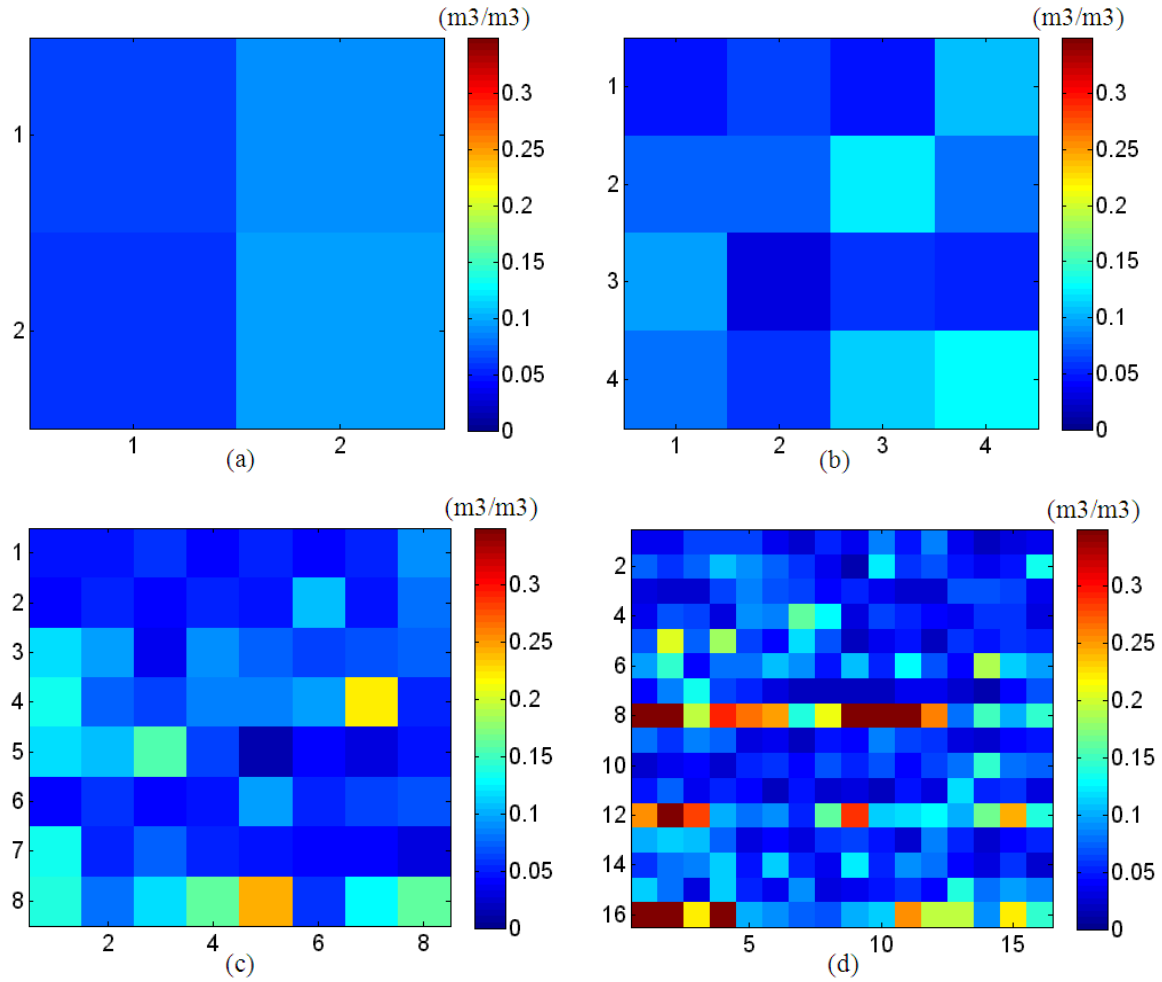


Figure 7. Soil moisture map of SMEX03 acquisition on July 10, 2003 at (a) level 1, (b) level 2, (c) level 3 and (d) level 4.

Results and discussions

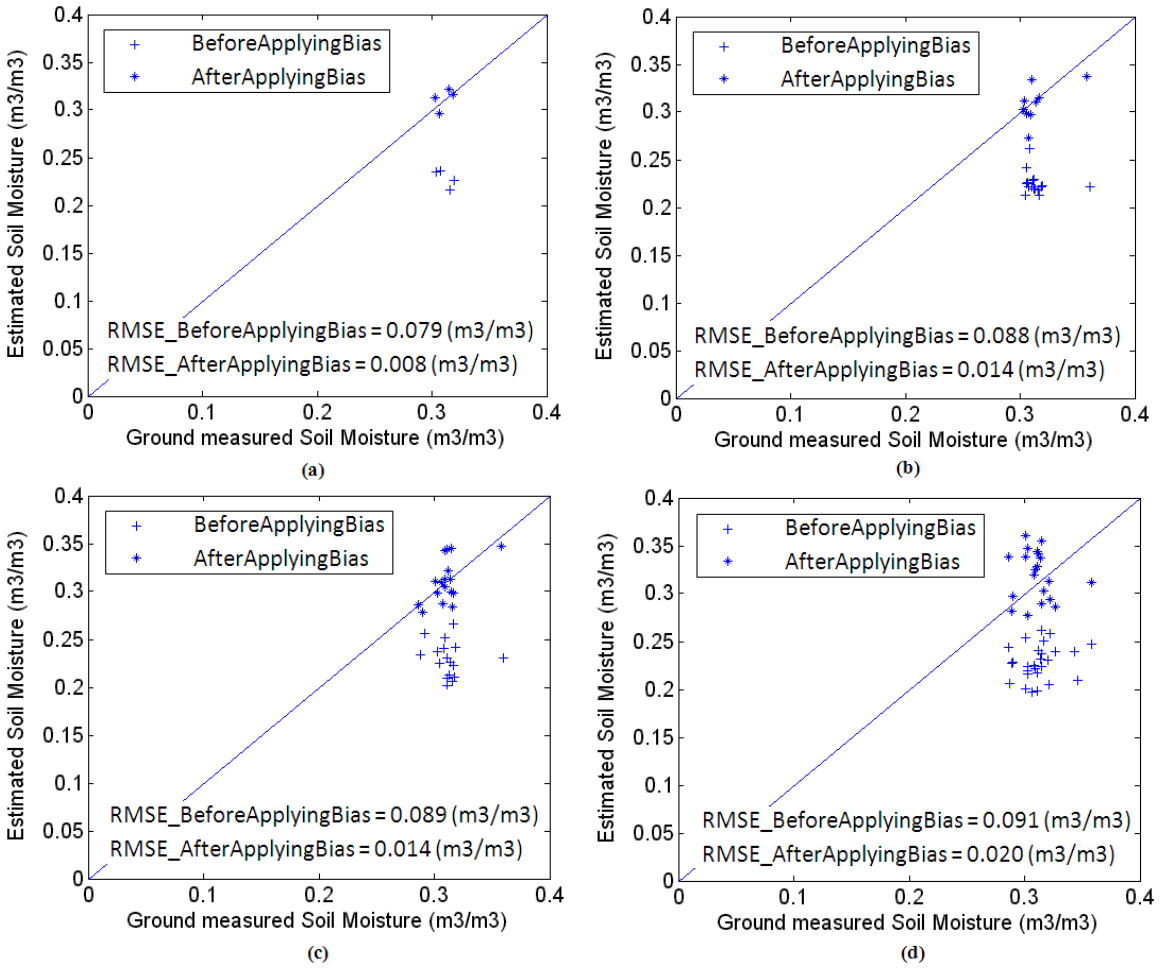


Figure 8. SMOS disaggregated soil moisture versus ground measurements at different levels: (a) level 1, (b) level 2, (c) level 3 and (d) level 4 for control points.

Results and discussions

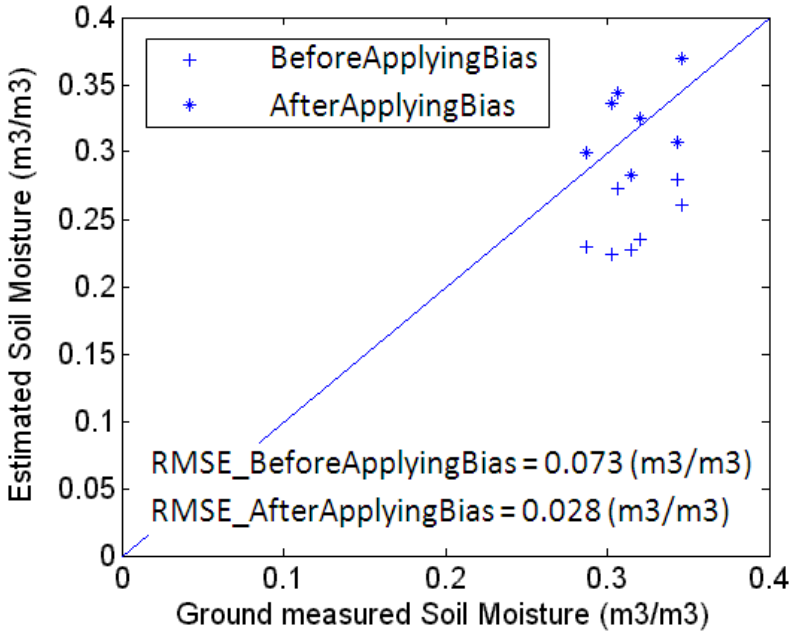


Figure 9. SMOS disaggregated soil moisture versus ground measurements at level 4 for check points.

Results and discussions

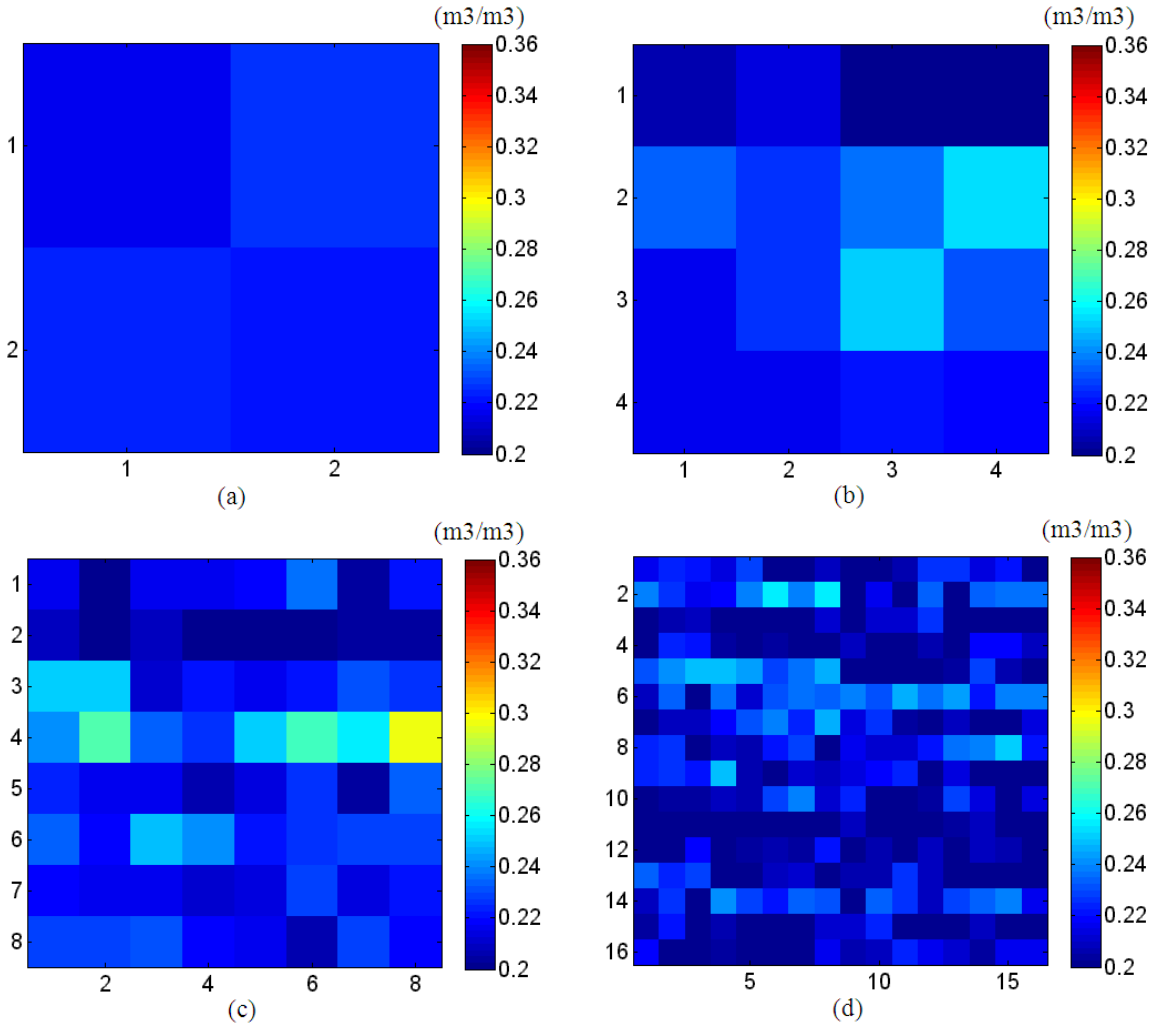


Figure 10. Soil moisture map of SMOS acquisition before applying bias correction on June 2, 2010 at (a) level 1, (b) level 2, (c) level 3 and (d) level 4.

Results and discussions

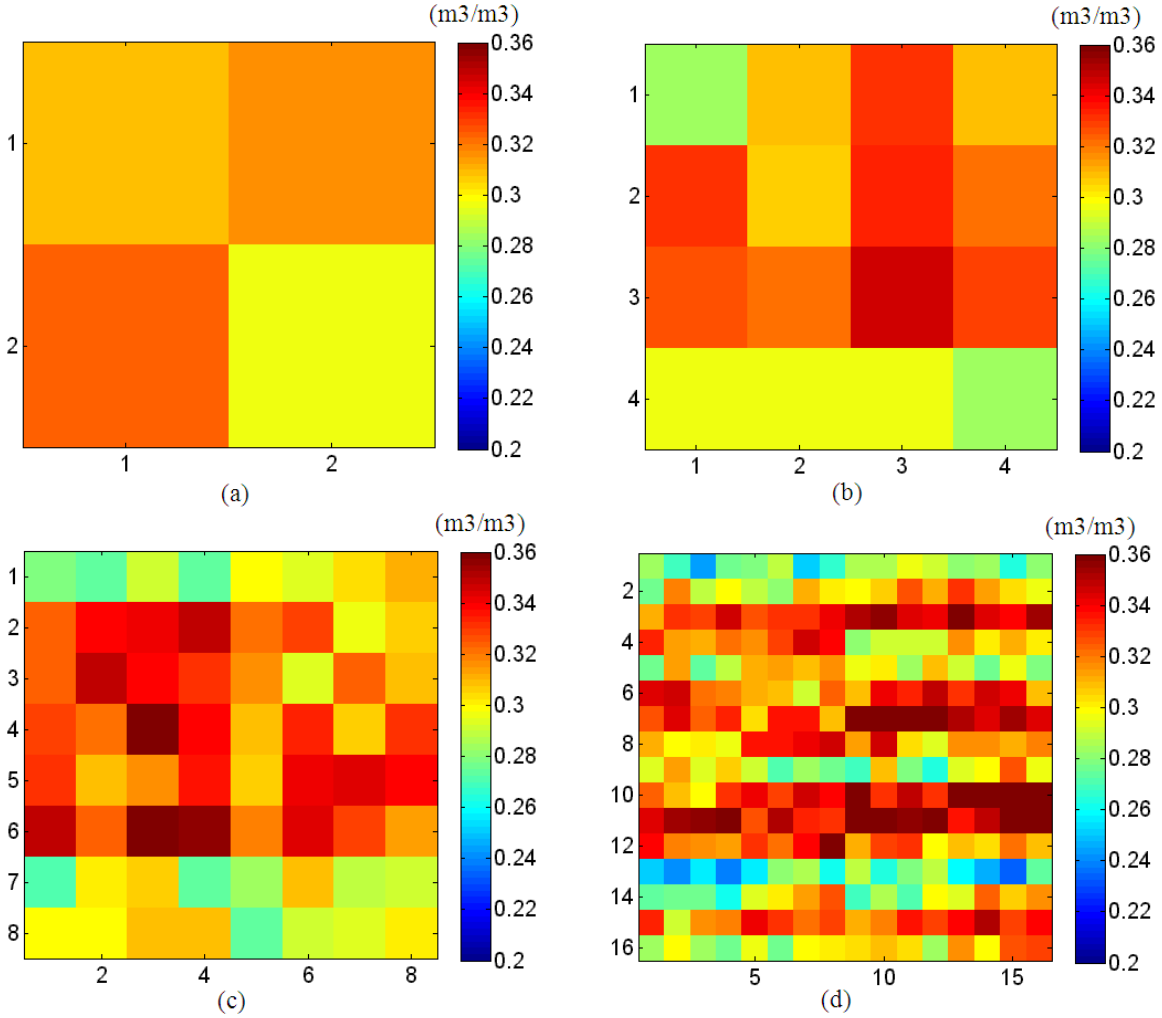


Figure 11. Soil moisture map of SMOS acquisition after applying bias correction on June 2, 2010 at (a) level 1, (b) level 2, (c) level 3 and (d) level 4.

Results and discussions

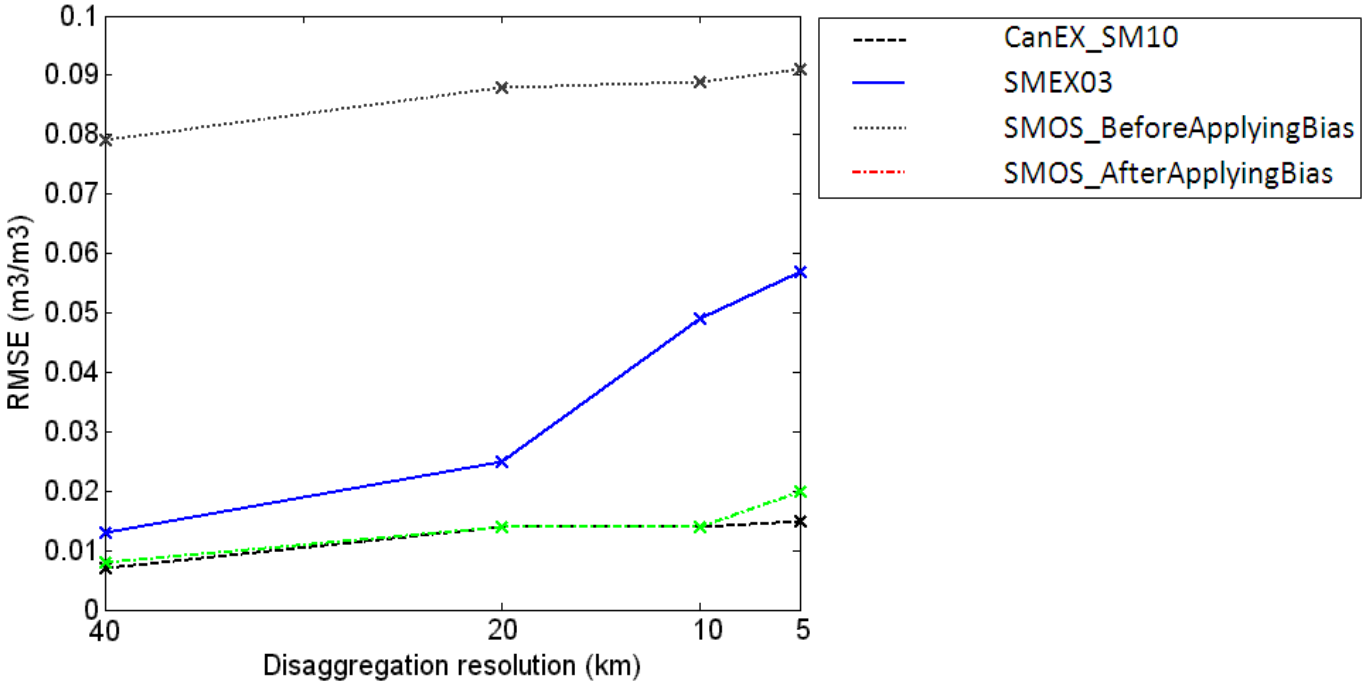


Figure 12. Trend of RMSE values between ground measured soil moisture values and estimated soil moisture values obtained from control points for both of the study areas.

Results and discussions

Table 1: RMSE values for different levels of soil moisture disaggregation obtained from CanEx-SM10, SMEX03 and SMOS acquisitions on June 2, 2010, July 10, 2003 and June 2, 2010, respectively.

Acquisition dates		RMSE (m^3/m^3) values of soil moisture disaggregation			
		Level 1	Level 2	Level 3	Level 4
CanEx-SM10 02/06/2010		0.007	0.014	0.014	0.015
SMEX03 10/07/2003		0.013	0.025	0.049	0.057
SMOS 02/06/2010	Before applying bias	0.079	0.088	0.089	0.091
	After applying bias	0.008	0.014	0.014	0.020

Summary and Conclusion

- Multiplicative random cascade model was used to disaggregate low resolution soil moisture generated from ground measurements and also SMOS soil moisture.
- Average soil moisture over areas of 80 km × 80 km was disaggregated at 4 levels to provide soil moisture at improved resolution of 40 km, 20 km, 10 km and 5 km.
- Results show acceptable values of RMSE that increase with the level of disaggregation and the variability in ground measurements.
- The higher value of the RMSE obtained from SMOS soil moisture is ~ 0.028 m^3/m^3. So, the method presents good potential for soil moisture disaggregation in sparse vegetated and bare soil areas.
- It is necessary to account for spatial information (topography, vegetation, soil type, etc.) affecting the spatial distribution of soil moisture. This can be done through an improved version of the model named the random cascade hierarchical and statistical adjustment (RCHSA) method (Shrestha et al., 2004).